in a mold under controlled pressure and a non-oxidizing atmosphere. The carbon foam thus produced exhibits several unique properties, perhaps the most unusual one being a very low thermal conductivity, below 1 W/m °K in the ungraphitized state. The other physical properties of these materials are largely isotropic, i.e. relatively equal in all directions. Such foams because of their method of manufacture directly from untreated (not extracted in any way) coal also contain ash that is a result of the direct foaming of the comminuted coal.

There are two major classes of prior art that must be addressed and that are clearly distinguishable from the instant product and process, These classes of prior art relate to so-called "coke" and what are referred to herein as "graphitic" foams, i.e carbon foams produced in one fashion or another from coal or petroleum pitch after the extraction of the parent material.

The preparation of pitch for the production of "graphitic" foams requires extraction or other treatment of the coal to extract the pitch from the parent coal. The pitch is then subjected to a foaming process. It is respectfully submitted that this is considerably and patentably distinguishable from the process of the present invention that uses coal directly as the starting material for the foaming process with no prior treatment, extraction etc. of any kind. As to the product, "graphitic" foams contain no ash as this is removed in the pitch extraction process. Additionally, such foams are known and utilized for their relatively high thermal

conductivities that are significantly above those demonstrated by and now claimed for the present materials.

"Coking" to produce "coke" on the other hand, starts with coal as the starting material and simply heats it in an uncontrolled fashion until sufficient volatiles have been driven off as to provide a reducing and supporting medium useful in, for example, the production of iron from iron ore. The heating process is not controlled either as to non-oxidizing atmosphere or pressure and is not performed in a "mold". Accordingly, the "coke" produced has a structure much like Swiss cheese with large voids with masses of solid therebetween. The physical properties of these materials are entirely random and they would not be conventionally referred to as "foams".

In view of the foregoing remarks, entry of the additional claims is respectfully requested. "Clean Copy" and "Marked-Up" copies of the added claims is enclosed herewith.

Respectfully submitted,

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39) The method of claim 6 wherein said carbon foam has a density of between about 0.3 g/cm^3 and about 0.4g/cm^3.

40) A semi-crystalline, largely isotropic, coal-based carbon foam having a thermal conductivity below about 1 W/m/°K.

41) The carbon foam of claim 1 having a density of between about 0.1 and about 0.8 g/cm^3.

42) A coal-based carbon foam produced by the direct heating of comminuted coal particles in a pressure controlled mold and under a non-oxidizing atmosphere to a temperature ranging from about 300° C to about 700° C.

43) A method for producing carbon foam comprising directly heating comminuted coal particles in a pressure controlled mold to a temperature ranging from about 300° C to about 700° C.

44) A method for producing a coal-based carbon foam comprising:

A) comminuting coal containing adequate volatiles to permit foaming thereof upon the application of heat, to a small particle size to form a ground coal;

B) placing said ground coal into a mold;

C) heating said ground coal in said mold under a non-oxidizing atmosphere to a temperature and for a period adequate to produce a controlled foaming of said coal to form a preform; and

D) controllably cooling said preform.

Abstract

According to the present invention there is provided a coal-based carbon foam having a density of between about 0.1g/ cm^3 and about 0.8 g/cm^3, preferably between about 0.2 g/cm^3 and about 0.6 g/cm^3 and most preferably between about 0.3 g/ cm^3 and about 0.4 g/cm^3 that is produced by the controlled heating of high volatile bituminous coal particulate in a "mold" and under a non-oxidizing atmosphere. The high volatile bituminous coal starting material preferably exhibits a free swell index of between about 3.5 and about 5.0 and most preferably between about 3.75 and about 4.5. A number of additional highly desirable characteristics of the high volatile bituminous coal starting material are also described. The carbon foam product thereby produced can be machined, adhered and otherwise fabricated to produce a wide variety of low cost, low density products, or used in its preformed shape as a filter, heat or electrical insulator etc. Such carbon foams, with treatment exhibit compressive strengths of up to about 6000 psi. Further treatment by carbonization or graphitization yields products that can be used as electrical or heat conductors. Methods for the production of these coal-based cellular products are also described.